

B5: Enzymes

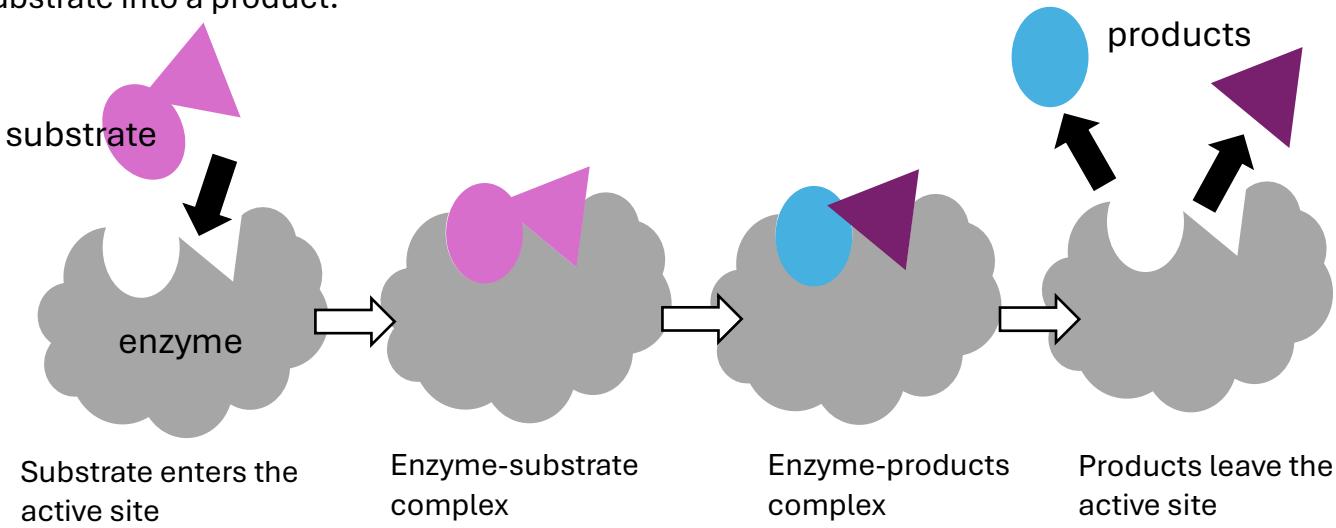
- 1 Describe enzymes as proteins that are involved in all metabolic reactions, where they function as biological catalysts
- 2 Investigate and describe the effect of changes in temperature and pH on enzyme activity
- 3 Describe and explain enzyme action with reference to: the active site, enzyme-substrate complex, substrate and product
- 4 Describe and explain the specificity of enzymes in terms of the complementary shape and fit of the active site with the substrate
- 5 Explain the effect of changes in temperature on enzyme activity in terms of kinetic energy, shape and fit, frequency of effective collisions and denaturation
- 6 Explain the effect of changes in pH on enzyme activity in terms of shape and fit and denaturation

Enzymes are proteins that speed up chemical reactions in the body. They are involved in all body reactions, like digestion and respiration.

Enzymes act as biological catalysts — they are not used up in the reaction.

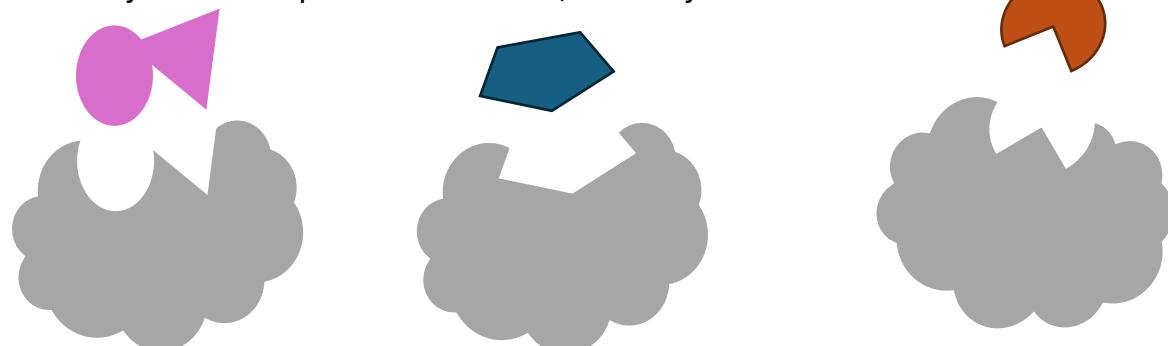
How do enzymes work?

Enzymes have a special area called an active site. The substrate (the molecule to be changed) fits into the active site. This forms an enzyme-substrate complex. The enzyme turns the substrate into a product.



Enzymes are specific.

Each enzyme has an active site that is a specific shape. Only one type of substrate fits — like a lock and key. If the shape doesn't match, the enzyme won't work.



How does temperature affect enzyme activity?

Enzymes work best at their optimum temperature (usually around 37°C in humans).

- Too cold: reaction is slow.
- Too hot: enzymes become denatured (they lose their shape and stop working).

Higher temperature = more kinetic energy = particles move faster.

More frequent collisions = more enzyme activity.

Too much heat changes the enzyme's shape = it no longer fits the substrate (denatured, they lose their shape and stop working).

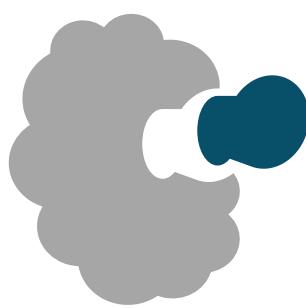
How does pH affect enzyme activity?

Each enzyme works best at its optimum pH.

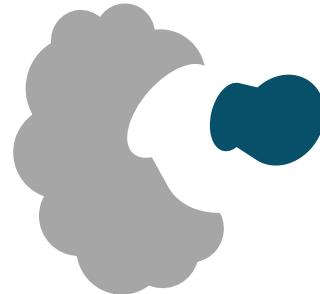
E.g. Stomach enzymes like acid (low pH); intestinal enzymes prefer alkaline.

Wrong pH changes the shape of the active site. Substrate no longer fits = enzyme is denatured. Activity slows or stops.

Normal enzyme



Denatured enzyme



Glossary

Active site – The part of an enzyme where the substrate fits and the reaction takes place.

Biological catalyst – A substance (like an enzyme) that speeds up chemical reactions in living organisms without being used up.

Catalyst – A substance that speeds up a chemical reaction without being changed or used up.

Denatured – When an enzyme's shape changes so that it no longer works (often caused by high temperature or incorrect pH).

Enzyme – A protein that speeds up (catalyses) chemical reactions in the body.

Enzyme-substrate complex – The temporary structure formed when a substrate binds to the enzyme's active site.

Lipase – An enzyme that breaks down fats and oils into fatty acids and glycerol.

Lock and key – A model that explains how enzymes and substrates fit together based on shape.

Metabolic reactions – All the chemical reactions that happen in a living organism to keep it alive.

Optimum – The best condition (e.g. temperature or pH) for an enzyme to work at its fastest rate.

pH – A scale that shows how acidic or alkaline a substance is. Enzymes have an optimum pH.

Product – The substance(s) produced by an enzyme reaction.

Protease – An enzyme that breaks down proteins into amino acids.

Substrate – The molecule that an enzyme acts on in a chemical reaction.

Temperature – A factor that affects how fast enzymes work; too high can cause denaturation.

Specificity – The idea that enzymes only work with one kind of substrate due to the shape of the active site.